MINERALS IN FORAGES: COW CONSIDERATIONS

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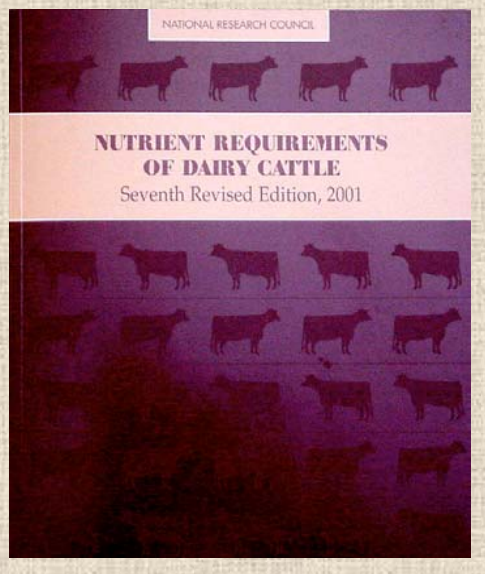
FOCUS OF PAPER AND PRESENTATION

- **MACRO MINERALS (Ca, P, K, Mg, Na, Cl, S)**
  - ✓ **Forage mineral content**
    - **Quantity**
    - **Availability**
  - ✓ **Lactating and transition cow requirements**
  - ✓ **Feeding considerations**

FORAGE MINERAL CONTENT

- *Are 'book values' accurate?*
  - 2001 Dairy NRC updated information
  - Legume and grass forages listed by NDF and not species
  - Grain silages
- *Analysis better than book values*
  - Wet chemistry better than NIR



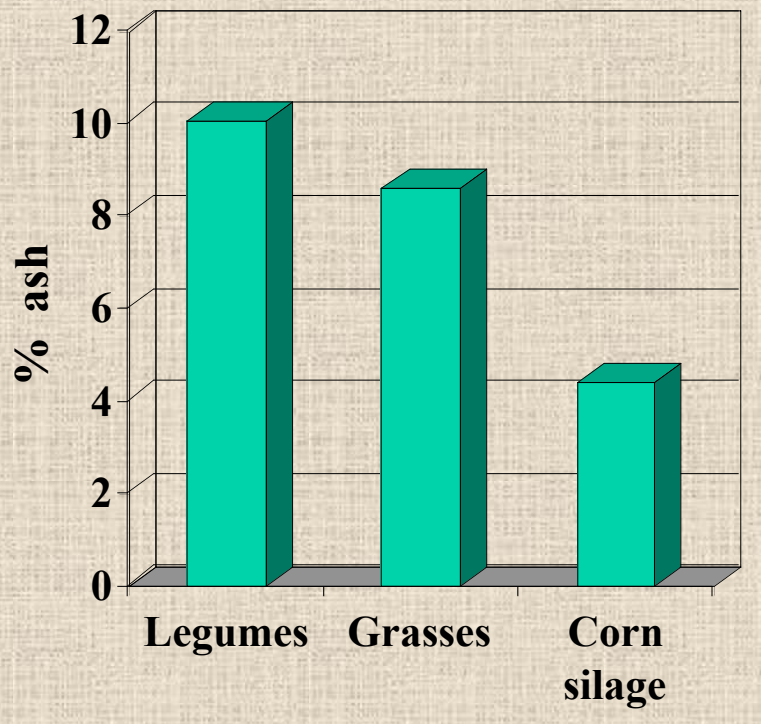
ASH

TOTAL MINERAL CONTENT

Ash analysis important

- **Inverse of organic matter (energy)**
- **Soil contamination**
- **Soil microorganisms**

  Molds, Mycotoxins
- **High levels may decrease feed intake (>9% diet)**



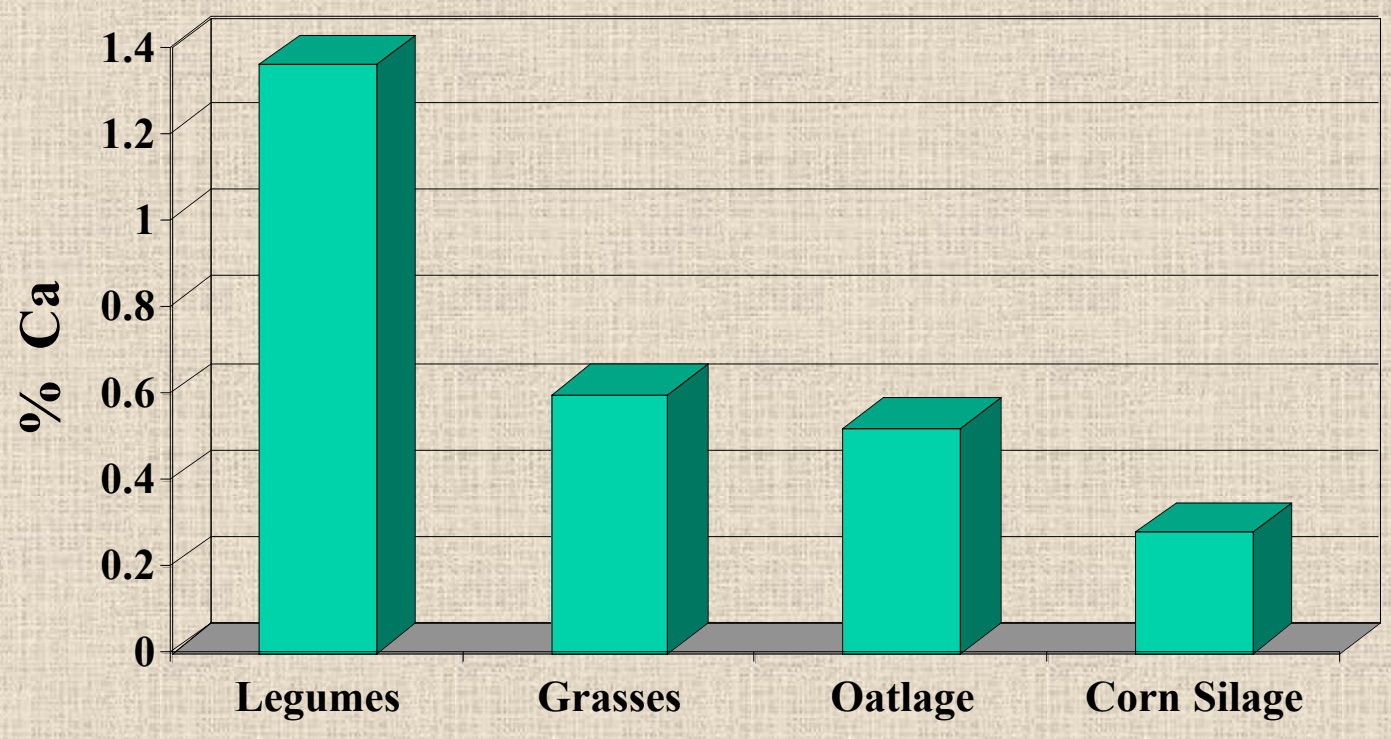
HOW MUCH EXTRA “MINERAL” ARE COWS GETTING?

ABILITY OF FORAGES TO MEET MINERAL REQUIREMENTS

- **QUANTITY**
  (Total Amount)

- **AVAILABILITY**
  (Amount cows can absorb from the digestive tract)

Calcium (Ca) in Forages



Ca Availability

Feed	Factor, %
Forages	30
Grains	60
Mineral supplements	50 - 95

Alfalfa @ 1.6% Ca = Available Ca 0.39%
(1.6 x .3)

Calcium and Cow Considerations Transition Cow

Feed	Lb DM	% Ca	Avail %	Avail g
Alfalfa	11	1.7	30	25
Corn Silage	11	0.3	30	5
Total diet	22	1%		30
275 d Preg req't				21
Requirement				50
30 lb colostrum				

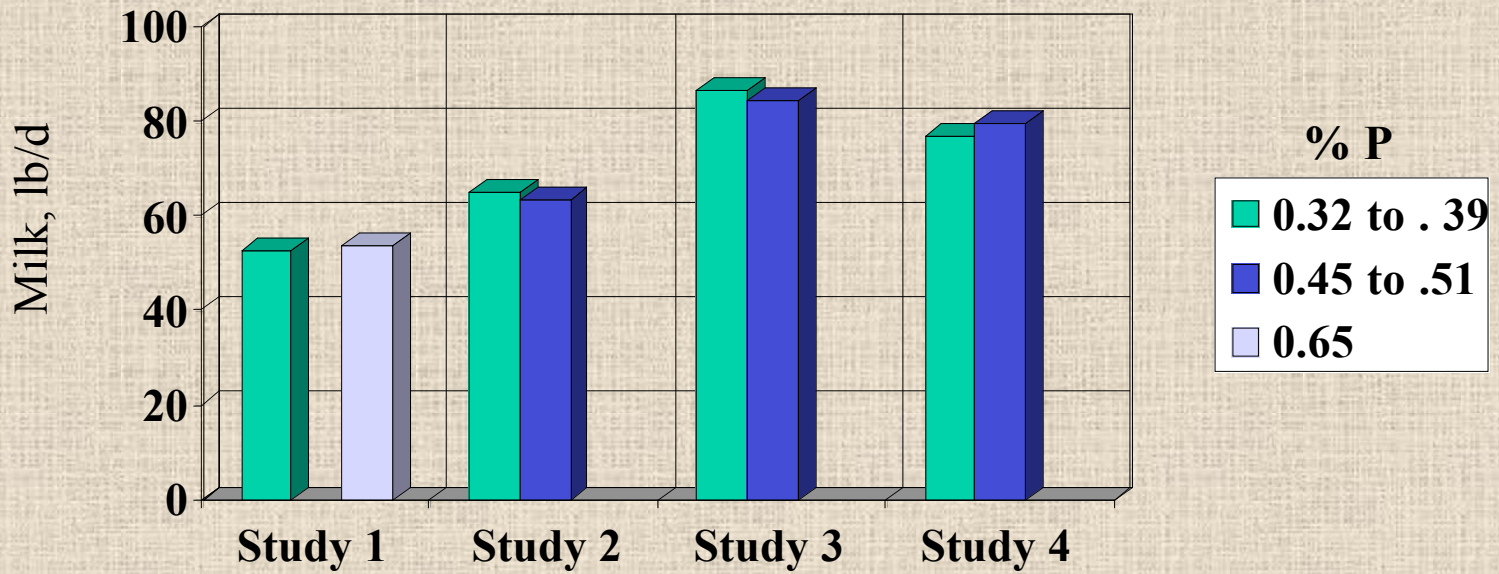
Calcium and Cow Considerations

- Ca only 30% available from forages
  - Lactating cow diets with alfalfa may need Ca supplementation
- Availability
  - Grains (60%)
  - Supplements (50 – 95%)
- Balance diets to meet Ca requirements
  - Lactating cows - .75 - .9%
  - Closeup cows - 1 – 1.5%

Phosphorus (P) Facts

- **Availability**
  - **Forages - 64%**
  - **Concentrates - 70%**
- **P content of most forages - 0.25 to 0.35%**
- **Phosphorus requirements - amounts not % of diet**
- **High phosphorus diets do not improve milk production or reproduction**

Milk Production Responses to Dietary Phosphorus (Satter et al. 1999)



P Requirements and Excretion

	275 day Preg 22 lb DMI	100 lb milk 55 lb DMI
P requirement, g/d	32	69
Diet availability, %	67	67
Dietary Req't, %	0.48	0.41
Excretion at Req't g/d	16	33
Yearly excretion/cow 60 d dry, 305 d lactation	24 lb/cow – unavoidable	

Magnesium in Forages

- **Quantity**
  - **Legumes - 0.25 to 0.3%**
  - **Grasses – 0.20 to 0.25%**
  - **Grain silage – 0.15 to 0.20%**

Availability 16% for all forages

Magnesium and Cow Considerations

Absorbed from the rumen

- **Magnesium sources must be soluble in rumen**
- **Factors affecting Mg solubility/absorption**
  - **» Rumen pH - better below 6.5**
  - **» High K diets (>1.5%) decrease solubility**
  - **» K:Mg ratio < 4:1 for good absorption**
  - **» Low solubility/absorption of Mg in most feedstuffs (10 to 30%); Supplements - 5%**

Mg Requirements

	275 day Preg 22 lb DMI	100 lb milk 55 lb DMI
Mg requirement, g/d	2.5	9
Diet availability, %	16	16
Dietary Req't, %	0.16	0.23
Diet Recommend, %	0.3 to 0.4%	0.3 to 0.35%

Cations and Anions

"Electrolytes"

Cations

Positive charge

Sodium (Na)

Potassium (K)

Anions

Negative charge

Chloride (Cl)

Sulfur (S)

Dietary Cation Anion Difference

(Na + K) – (Cl + S)

Potassium (K) in Forages

- **Quantity**
  - **Legumes – 2.0 to >3%**
  - **Grasses – 1.5 to >3%**
  - **Corn sil – 1.0 to 1.5%**
  - **Grain sil – 1.5 to >3%**

Availability 85 to 90% for all forages

Minerals in Milk

Mineral	%
Potassium	0.13
Calcium	0.12
Chloride	0.09
Phosphorus	0.09
Sodium	0.05
Sulfur	0.03
Magnesium	0.01

K Requirements

	275 day Preg 22 lb DMI	100 lb milk 55 lb DMI
K requirement, g/day	53	256
Diet availability, %	90	90
Dietary Req't, %	0.60	1.14
K feeding period, weeks	3 Low	45 High

Potassium and Cow Considerations

Potassium - lactating cows

- Milk
- Heat stress – cows sweat K
- >1.5% K in diet

Potassium – closeup cows

- Factor in milk fever
- High levels reduce Mg absorption
- < 1% if possible

Sodium (Na) in Forages

Less than .05% in all forages

Availability 90%+ for all feeds

Major sources of Na

- **Salt**
- **Buffers – Na bicarb/carbonate**

Na Requirements

	275 day Preg 22 lb DMI	100 lb milk 55 lb DMI
Na requirement, g/d	12	52
Diet availability, %	90	90
Dietary Req't, %	0.14	0.23
Diet Recommend, %	<0.2% Factor in milk fever	0.3 to 0.5% Milk response

Chloride (Cl) in Forages

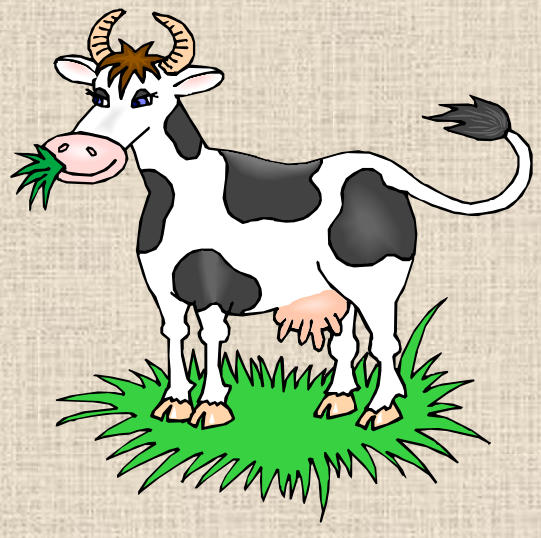
Legume/Grass forages - 0.5 to 1.0%

Corn silage – 0.2 to 0.4%

Availability – 90%

Major source

- **Salt**
- **Legumes and grass forages**
- **Supplements**



Cl Requirements

	275 day Preg 22 lb DMI	100 lb milk 55 lb DMI
Cl requirement, g/d	16	66
Diet availability, %	90	90
Dietary Req't, %	0.18	0.27
Diet Recommend, %	> 0.5% Factor in milk fever	< 0.5% Milk response

Na and Cl Feeding Considerations

Cl content of forages ?

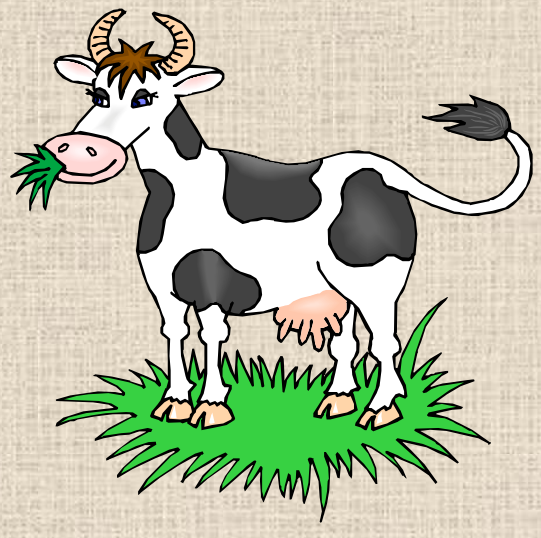
- **Accurate analysis (.5 – 1% forages)**
- **Availability**

Buffers supply Na

- **Excess of Na requirement**

Cows appear to require salt

- » **Lactating – 4 oz/day**
- » **Dry – 1 oz/day**



Sulfur (S) in Forages

Related to protein content

- **Legumes – 0.25%**
- **Corn silage - 0.1 to 0.15%**

Requirement is for rumen microbes

Nitrogen (N) to S ration

10 to 12:1 in diet

S Requirements

	275 day Preg 22 lb DMI	100 lb milk 55 lb DMI
S req't to support yield of microbial protein, g/d	20	54
Diet availability, %	100	100
Dietary Req't, %	0.2	0.22
Diet Recommend, %	<0.4% Factor in milk fever	0.2 to 0.3%

Cations and Anions

"Electrolytes"

Cations

Potassium

- Culprit in milk fever
- Highest requirement in lactation (> 1.5%)

Sodium

- Milk production may be enhanced by feeding above requirement (~ .15%)

Anions

Chloride

- Transition ~ .5%
- Lactation - excess may reduce milk in hot weather (>.5%)

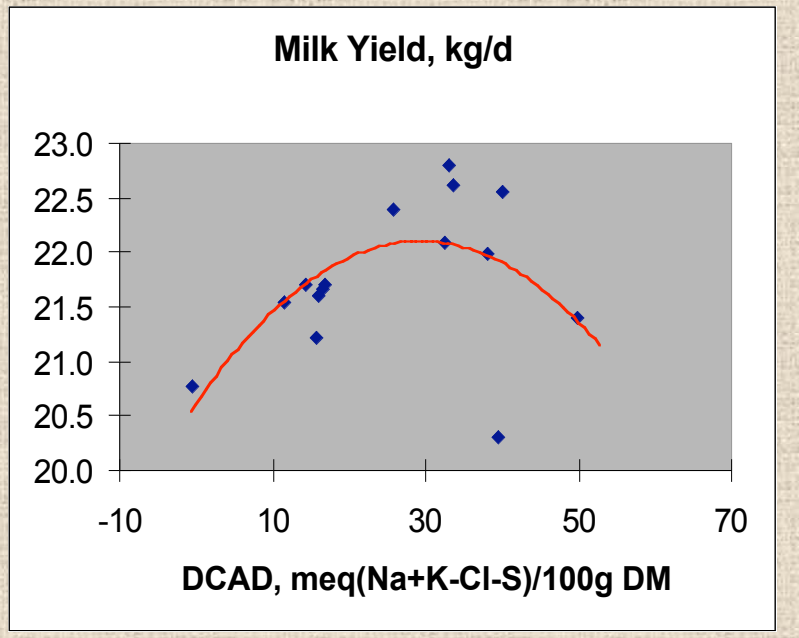
Sulfur

- Requirement ~ .2%
- Toxicity ~ .5%

DCAD Balances

Lactating cows

+30 meq/100g DM



Sanchez et al., 1994

Closeup Cows

No salts

< 10 meq/100 g DM

Salts

-10 or greater meq/100g DM

Measure urine pH < 6.5

SUMMARY

- **Forages are an important source of macro minerals for dairy cattle**
- **Diet formulations must consider**
  - ✓ **Amount**
  - ✓ **Availability**
  - ✓ **Interactions between minerals**
- **Excesses are as much of a concern as deficiencies**

Thanks for Listening

QUESTIONS